Synopsis on

Middleware for Unified Internet of Things Framework

Submitted To

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

For the award of degree of

Doctor of Philosophy

In the Subject of

Department of Computer Science and Engineering under the Faculty of Engineering

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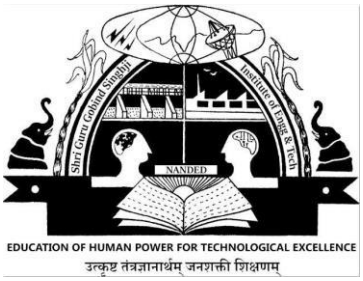

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March 2022

1. Introduction and Motivation

The Internet of Things (IoT) network is formed by the interconnection of digital and physical objects. That objects may be car, patient, home, devices, equipments, etc. through internet all devices will be connected to IoT framework. In Today's world technologies such as Internet of Things, Cloud Computing as well as Fog Computing are growing at an exponential rate which depend upon each other directly or indirectly. The Internet of Things can be described as a network of substantial matter such as cars, washing machines, refrigerator which can interact with each other through internet. Billions of devices will be IoT enabled in near future and generate enormous amount of data but IoT devices has some limitations like storage capabilities, processing capabilities and utilization of resources which can only be handled by integrating it with cloud technology [1]. The Internet of Things (IoT) can create disruptive innovation in healthcare. Thus, during COVID-19 Pandemic, there is a need to study different applications of IoT enabled healthcare [2]. These objects can be connected to the Internet by using suitable information and communication technologies like sensors, actuators and RFID (Radio Frequency Identification Device). IoT enabled things to interact autonomously with minimal human intervention. The environment in which IoT enabled things are placed becomes smarter. The IoT concept has evolved into and from different technologies like sensors, machine learning, real-time analysis, and embedded systems. It is about the smart hospital concept and other devices controlled by fixed or Wireless Internet. Smart devices can capture data and share it in daily life to accomplish the required task. IoT applications are reaching smart cities, cars, devices, entertainment systems, homes, and connected healthcare [2]. The Internet of Things (IoT) is an extended and expanded system network based on the Internet, and its ultimate goal is to achieve realtime interaction among things, machines and humans through various advanced technological means [3]. In every second different IoT healthcare devices are inventing and new technology is taking over its position. Upgrading from the current medical system and existing network configuration to the latest IoT based system and network is a major challenge [4]. IoT based real-world services are becoming increasingly popular along with traditional web-based services. Internet of Things has great potentials and opportunities cater to. However, it is not straight forward to manage things to accomplish seamless integration of the real-world and cyber world. The IoT can be described by very large scale network of things, diversity of connected devices (things), and a huge volume of events generated by interaction among these things. IoT system once built and deployed has to remain operational for a decade or more depending upon organization budget. New devices and users will be added to such the IoT system with time. It should be capable of handling

the increasing number of devices and users without compromising response time of served requests. IoT middleware should be capable of handling this growth (scalability). IoT has attracted the attention of researcher recently. It has become a hot research area, huge volume research is published for device layer, middleware layer, application layer and issues pertinent to each layer. Scalability of IoT middleware (and IoT system in general) has remained a neglected research area. The data generated by many objects should also be analyzed with reference to temporal, time series, real time, etc. Data generated by devices may need urgent attention. Few data is connected with other data i.e. time-series data and real time data needs urgent attention but these kind of issues not taken into consideration by researchers. In 2008, the number of computing devices connected to the Internet has exceeded the number of people on Earth [6]. The number of IoT devices worldwide is forecasted to almost triple from 8.74 billion in 2020 to more than 25.4 billion IoT devices in 2030. IoT enables the development of a wide range of powerful applications. These applications include smart city, smart grid, smart agriculture, transportation, health care, industrial automation, smart home, and environmental monitoring, etc. [7]. Middleware plays an important role in the realization of IoT systems. "Middleware is a software system designed to be the intermediary between IoT devices and applications. The middleware can offer common services for any kind applications and ease application development (from a developer perspective) by integrating heterogeneous computing and communications devices, and supporting interoperability within the diverse services running on IoT devices". In IoT scenario, it can act as a bridge between underlying sensor networks and user applications. The IoT middleware should address the following requirements: interoperability, security, scalability, service discovery, service management, context-awareness, extensibility, data and event management, etc. [8]. Cloud computing offers huge computing power, voluminous data storage which can be used for IoT. However, it requires a lot of data transfer, huge bandwidth, and high latency. The fog computing is a recently introduced computing paradigm placed near the edge of the IoT network. Fog computing enables service provisioning with low latency, local processing and temporary storage [8]. The performance and scalability are closely related to each other. Performance measured in term of throughput which is the number of requests fulfilled per unit time, whereas scalability is the response of a system with respect to a significant increase or decrease in system load. The performance of a traditional computer system mainly depends on the speed of CPU, cache memory, available memory, network speed, and implementation of software with or without multi-threading support. In addition to these factors, the IoT is a distributed system consisting of user applications and services, IoT devices connected using different types of network and middleware components consisting of an application server, database server, messaging application, and resource

manager are all these components distributed among cloud and fog computing center. The performance and scalability analysis is complex and challenging. Technologies are rapidly advancing on a daily basis and they are made with a goal to make our lives easier. Healthcare industry has greatly benefitted from this technological advancement. It makes any long and tedious process easier to complete and allows doctors and medical personnel to use this amazing tool in a secure manner. Before technology was introduced in the healthcare industry, patients had to endure long waiting hours to get examined and staff had to complete tasks manually. Patients only interacted with the doctors through visits to the hospital, phone, and text. There was no way to monitor the patient's health continuously to make an immediate and accurate diagnosis. Internet of Things (IoT) and Artificial Intelligence (AI) in healthcare can help bring a tremendous change to medical analysis, disease diagnosis and patient care [15].

2. Literature Survey

Fog computing is an advanced variety of Cloud computing and with the help of fog model unwanted accidents can be reduced, latency can be decreased at some stage in decision making, enhanced privacy as all industry can analyze their specific data in the vicinity and accumulate secret and private data in its local servers, local server propel individually those data that is sharable with cloud. Fog computing model will give best result in various applications such as Real time health analysis [1]. IoT has an excellent capability to create high-quality results with the help of innovative technologies. In medical, it becomes a new reality of an innovative concept that provides the best service to COVID-19 patients and performs precise surgery.18–21 Complicated cases are easily handled and controlled digitally during ongoing Pandemic. IoT takes new challenges in the medical field to create excellent support systems for doctors, surgeons, and patients [2]. Integration of cloud with IoT devices encountered with many issues like Authorization, Heterogeneity, Data processing or latency, Data Filtering, Operational Reliability, Big data, etc. Implementation of FOG in IoT was done by researchers. Various applications are using fog computing framework like Healthcare, Augmented Reality, Caching and pre-processing. A cluster based fog computing model was designed [1]. Cluster based approach used for IoT environment. IoT functions may not work because some node failure in IoT framework [3]. A variety of healthcare researches and enlist different healthcare technologies, applications,

services, protocols, networks, Security and its requirements, security challenges, different proposed and implemented security models, market opportunity, and open issues to be faced for the IoT. IoT HEALTHCARE METHOD like Radio Frequency Identification, Edge Computing, Semantics, Cloud Computing, Big data, Grid Computing, Augmented Reality, used [4]. Internet of Things has been one of the catalysts in revolutionizing conventional healthcare services. With the growing society, traditional healthcare systems reach their capacity in providing sufficient and high-quality services. The world is facing the aging population and the inherent need for assisted-living environments for senior citizens. N-HOME health monitoring allows patient care to continue at home after a patient is discharged from the hospital. By tapping on the ubiquitous computing power and sensing ability, IoT fueled eHealth applications to improve and foster better diagnostics, consultation, drug administration, and preventive advice. IoT plays the main role in gathering and disseminating information either to the users themselves as health status feedback, within the healthcare organization, or between the patients and remote doctors for fuller information about the users' current and past health conditions and living environment [5]. Homogeneous and heterogeneous Wireless sensor network and IoT based have various critical and non critical applications impacting various ways explained by authors [9]. Various security issues can be handled by using blockchain. Various transaction process discussed by authors to provide secure environment. Blockchain and IoT integration approach suggested by author [10]. IoT Fog-Edge-Cloud architecture explained and use of IoT, security issues, laws in different countries, international standards elaborated [11]. An IoT based healthcare platform introduced in covid-19 outbreak. Home hospitalization system using IoT was introduced during pandemic situation. ICU bed monitoring system using IoT was introduced by researchers [12]. Security issues, attacks and solutions discussed by authors regarding IoT and blockchain integration. The blockchain paradigm is changing the IT industry. Blockchain can bring together companies, governments, and even countries. Blockchain technology is widely recognized and highly valued due to its decentralized nature and peer-topeer characteristics. Analysis of several attacks on blockchain and the security issues of blockchain with some real-world examples discussed. The various security issues, challenges, vulnerabilities, and attacks that impede the increased adoption of blockchain technology while exploring these challenges in a variety

of aspects [13]. Survey of multiple contributions, technologies, techniques, type of securities, security issues, and corresponding industries was done by authors. Multiple security issues proposed framework/model, experiments and result discussed.Multiple framework/model, algorithms, security services, experiment evaluation, and result discussed [15]. Designed a novel framework for capturing, analyzing, and identifying IoT botnets. The framework captured, analyzed, and reported 4077 unique samples from IoT botnets propagating on the Internet. The framework also facilitates botnet suspension by reporting the botnet samples to a blacklist and abuse service. The in-depth analysis has identified that some IoT botnets used anti-sandbox, anti-forensics, and/or persistence techniques typical for traditional botnets. Several botnets also used techniques to evade network detection and to hide C2 communication. More than half of the captured botnets (52%) were classified as Mirai variants, showing the impact the release of the Mirai source-code had on the threat landscape. Authors addressed the identified anti-honeypot techniques with appropriate countermeasures to reduce the risk of honeypot detection. Thus, it is necessary to continuously monitor the honeypots' activity and to apply the appropriate countermeasures when a new anti-honeypot technique is discovered. Similarly, the cybercriminals may also develop new anti-analysis techniques aimed to thwart or deceit the static and dynamic analysis of the botnet samples [14].

3. Problem Statement and Objectives

This research is aimed towards Enhancing IoT framework capabilities. Objectives are as follows.

(a) To develop method for identification of FOG node should be able to identify the data generated by IoT devices is time sensitive or not.

(b) To develop the method for IoT to monitor vital sign (fault or other issue) of patient/equipment in real time environment.

(c) Design and development of unified IoT framework that satisfies global requirements.

4. Plan of Research Work

Phase	Work To Be Carried Out
I	- Literature Survey - Formulation of Problem Definition, Objectives and Feasibility Study.
II	- Survey paper publication - Design and Develop method for above stated problem
III	- Testing and Performance Evaluation. - Publications in reputed journals and Thesis Writing

5. Impact on Society: Time series data or temporal data generated by IoT devices is very important for patients, equipments, etc. and we should have some mechanism to identify it and give priority to take prompt action within stipulated time. The IoT is beneficial for agriculture sector, healthcare industries, patients, chemical industries. Many products like transportation vehicles, healthcare, agriculture, industrial and utility components, sensors, and other everyday objects which are being combined with Internet connectivity and have powerful data analytic capabilities that promise to transform the way we work, live, and play. The benefits of the IoT on citizens, blind person, kids, businesses and governments will be significant, ranging from helping governments reduce healthcare costs and improving quality of life, to reducing carbon footprints, increasing access to every goods.

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